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PROJECT MASTER PLAN FOR THE SONAR SYSTEM CALIBRATION AND ALIGNM--ETC(U)
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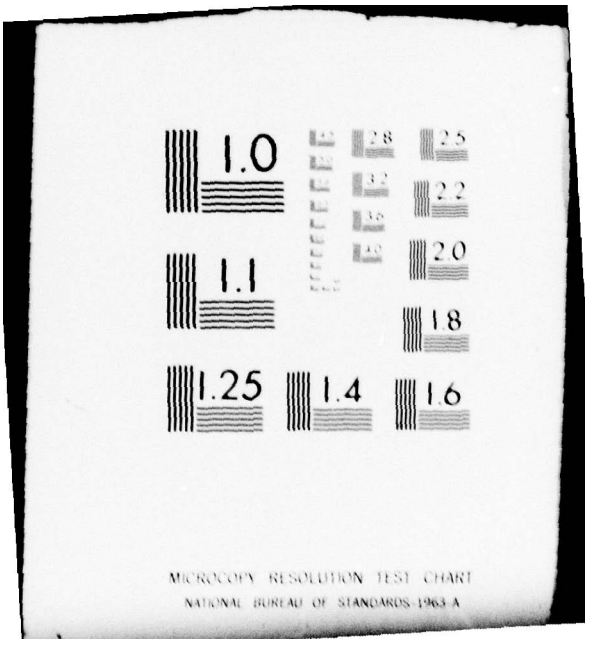
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DEPARTMENT OF THE NAVY

LEVEL II

PROJECT MASTER PLAN FOR THE SONAR SYSTEM CALIBRATION AND ALIGNMENT EVALUATION PROGRAM (U)

NAVAL SHIP SYSTEMS COMMAND

15 NOVEMBER 1978

67 p.

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DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
WASHINGTON, D.C. 20360

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23 December 1966

From: Commander, Naval Ship Systems Command
To: Distribution List

Subj: Sonar System Calibration and Alignment Evaluation; Project Master Plan (PMP) for (U)

Encl: (1) Subject PMP

1. The subject enclosure describes the Sonar System Calibration and Alignment Program which will provide validated calibration alignment documentation to the Fleet (standards and procedures), establish sonar calibration and alignment cycles, and provide feedback from the Fleet on system design and effectiveness.

2. This plan recognizes the fact that the overall responsibility for system performance, including calibration and alignment, rests with the cognizant equipment Project Office. Therefore, test plans, standards, and documentation are all approved by the cognizant Project Officer prior to promulgation.

3. Standards for sonar as well as other sensors and systems will be promulgated in a single document by Manager, Anti-Submarine Warfare Systems Project. Procedures will be promulgated in technical manuals and by PMS.

4. All requests for, and comments relative to this publication, should be forwarded to NAVSHIPS, attention code 1622G.

5. This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or revelation of its contents, in any manner to an unauthorized person, is prohibited by law.

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SECTION 1

HISTORICAL DATA

A. BACKGROUND

Prior to 1959 the anticipated performance of ASW sensors was generally based on manufacturer's published specifications, and the actual performance of these sensors was virtually unknown. Early in 1959, during torpedo experiments in Dabob Bay that involved the services of the USS FALGOUT (DER 324) and USS CHARLES E. BRANNON (DE 446), the Applied Physics Laboratory, University of Washington, observed certain phenomena that could be explained only by the existence of an average bearing error of 17° in the AN/SQS-4 sonar on the FALGOUT and a bearing error of 6° in the same type sonar on the BRANNON. BRANNON was recalled to the range and the existence of the error was confirmed. In addition, a large sonar range error (approximately 30%) was found[1/*]. Subsequent tests on first-line Fleet ships with more modern sonars revealed a serious, Fleet-wide alignment and calibration problem, not only with sonars, but with other sensors (e.g., radars, gyro compasses) as well.

As a result of these latter tests, in April 1960 the Chief of Naval Operations initiated a joint BUWEPS-BUSHIPS program to review existing on-board checks and adjustment of ASW equipment, to establish alignment standards and

*Numbers refer to the Bibliography, page 1-11

improved methods of conducting on-board alignment checks, and to investigate the feasibility of ranges in the Fleet operating areas to verify alignment of sensors[2].

In late 1960-1961 additional ships were tested at Dabob Bay, with the program extended to check submarine sensors as well.

Early in 1962 a task was assigned to NEL to perform the following work[3]:

1. Sonar alignment accuracy studies, to include improvements to existing sonar as well as study and guidance for future sonar development. This effort was to include study of procedures and recommendations for sonar design improvement utilizing data obtained from alignment checks for ships scheduled at Dabob Bay.

2. Provide specifications for sonar equipment modifications, test equipment, and/or test procedures.

3. Provide technical guidance in equipment contracts.

4. Test and evaluate prototype equipment.

During this same period a number of shipyards were requested to furnish documents detailing current procedures and equipment used to align and calibrate submarine ASW sensors[4].

In March of 1962, a Sonar Alignment and Calibration Conference was held at APL/UW and NTS, Keyport. Attendees included representatives from BUSHIPS, BUWEPS, NOTS, NUOS, and the Naval Shipyards at Puget Sound, Mare Island, San Francisco and Norfolk. The results of the Dabob Bay testing program and the implications thereof were presented,

primarily for the benefit of the shipyards. Problem areas were defined, and recommendations were made for solutions to the problems. APL/UW presented its proposal for the establishment of calibration facilities in Fleet operating areas[5]. Another meeting was held at APL/UW in April 1962 to discuss the problem jointly among BUWEPS, BUSHIPS and the Fleet Type Commands.

B. ASW SYSTEMS ALIGNMENT CONFERENCE, 12-13 APRIL 1962

The purpose of this conference was to bring the Fleet up-to-date on the nature of the ship ASW sensor alignment and calibration problem and to review the programs for solution of the problem[6]. The BUSHIPS program contained the following major items:

1. Improve equipment design.
2. Establish realistic performance standards.
3. Provide adequate test instrumentation.
4. Review existing alignment procedures.
5. Establish training programs.
6. Provide motivation for accomplishing desired actions (shipyard and shipboard).
7. Make sensor checks, to include:

   a. Self-evaluation of sensors by use of alignment buoy and signal injector.

   b. Shipyard evaluation of sensors by use of Shipyard and Calibration Sites.

   c. Fleet commander evaluation of sensors by Fleet Operational Readiness Accuracy Check Sites to provide readiness data.

Out of this conference came several recommendations from Fleet commanders, including:

1. Provide adequate alignment and calibration procedures.

2. Establish FORACS and SACS.

3. Provide self-help hardware and procedures such as alignment buoy to the Fleet where possible.

4. Streamline maintenance instruction books and include adequate alignment and calibration procedures.

5. Provide specifications (standards) for alignment.

In addition to these recommendations, which were published along with the minutes of the conference by BUWEPS, other recommendations were made by both CINCLANTFLT[7] and CINCPACFLT[8] to CNO for the establishment of calibration stations.

C. PROGRAM ADVANCES, 1962-1965

As it relates to the sonar system evaluation program, the most significant single accomplishment during this period was the authorization and establishment of FORACS. Tentative Specific Operational Requirement (TSOR) S22-30T[9] was established by CNO in November 1962 to provide the means to measure both relative and absolute sonar and ASW fire control system errors by use of appropriate sonar-radar-optical targets for external alignment. The significant features included:

1. "Self-help" portable sonar/radar "posit" transponder buoys for checking relative sonar errors using F/C radar as a reference.

2. Shipyard Accuracy Check Sites (SACS) for measurement of absolute ASW system errors.

3. Fleet Operational Readiness Accuracy Check Sites (FORACS) for measurement of absolute ASW system errors.

The Bureau of Ships was designated the lead Bureau for the program. BUSHIPS completed a cost and time study in November 1962 for FORACS[10]. The purpose of the sites as stated by BUSHIPS was:

1. To check:

   a. Sonar Range and Bearing Accuracy.

   b. FC Radar Range and Bearing Accuracy.

   c. Surface Search Radar Range and Bearing Accuracy.

   d. Gyrocompass Accuracy.

   e. Optical sensors (periscope, pelorus, etc.) accuracy.

2. As a secondary purpose, to provide limited facilities and personnel for correction of deficiencies insofar as practicable.

The FORACS program was implemented by BUSHIPS in January 1963 by assigning responsibility for the installation at San Clemente to NEL[11] and asking BUWEPS for approval for APL/UW to establish the FORACS at St. Croix[12]. However, by request of CINCLANTFLT[13] the St. Croix location was changed by CNO to Guantanamo Bay[14].

The installation of FORACS I, SCI was completed by mid-1963. However, computer and operational difficulties precluded certification of the facility until June 1965[15].

FORACS II, Guantanamo, was installed except for the computer during mid-1963. An SDS 910 computer was installed in December and station operation began 1 April 1964. Due primarily to the difficulties encountered with FORACS I and the high level of effort applied to those problems, FORACS II was not certified until January 1965[16/], although operation was continuous from 1 April 1964.

In June 1963, CNO requested BUSHIPS to provide comprehensive plans for installing FORACS at Cape Cod, Massachusetts and in the Hawaiian Islands. A proposal was submitted in October to complete a study on problem areas and to develop final plans for installation in 1964[17/]. This proposal was approved and the final plan was submitted in February 1964[18/]. With approval by CNO[19/], work has progressed on these two sites. Although difficulties not encountered at FORACS I and II, such as the need for agreements with land-holders and requirement for MILCON approval, has delayed their completion, FORACS III, Oahu, was installed except for a computer in December 1965 and installation of FORACS IV, Cape Cod, will be completed late in 1966. The computer was delivered to FORACS III in April 1966; training of the range operators began in January 1966 and it is anticipated that the station will be certified during 1966.

D. SONAR CALIBRATION AND ALIGNMENT STUDY GROUP

By early 1965 more than 200 ships had been tested at FORACS and at Dabob Bay. The results demonstrated persistent below-standard performance of Fleet equipment. Growing concern over the inefficacy of the existing sonar calibration and alignment program, described previously,

prompted CNO to ask Manager, ASW System Project (MASWSP), to review the entire sonar calibration and alignment area[20]. In response to this request, MASWSP established the Sonar Calibration and Alignment Study Group (SCASG) in April 1965[21]. The specific tasks and objectives of SCASG are summarized as follows:

1. Investigate the requirements for a complete sonar calibration and alignment program and the steps necessary to meet these requirements.

2. Review and make recommendations on the necessity for and feasibility of present and proposed facilities to meet the requirements (e.g., FORACS).

3. Establish standardized procedures for sonar calibration and alignment.

4. Determine the dates when FORACS I, III, and IV will be ready for certification.

5. Establish standards for all equipments checked by FORACS.

6. Establish standardized FORACS reports for the Fleet and insure that the reports contain meaningful and useful information.

7. Establish a realistic "sonar calibration and alignment cycle" for ASW ships which will insure maintaining the approved standards.

8. Determine the necessity for establishing special calibration and alignment teams to assist ships in making necessary corrections and in assessing stability of alignment.

9. Include any other tasks deemed necessary in the sonar alignment area.

The work of SCASG was organized into two phases:

Phase I: Study the overhaul-to-overhaul cycle of sonar AN/SQS-23/23C.

Phase II: Extend the study to other sonars.

The Phase I study extended through the period May-July 1965. A report was submitted to MASWP[22]. In Phase II, which commenced immediately after submission of the Phase I report, it was decided by SCASG to investigate the AN/SQS-29/32C series sonars including Variable Depth Sonar (VDS). A report containing the Phase II findings was submitted to MASWSP[23]. Among the more significant accomplishments of SCASG were the following:

1. Determination of accuracy standards by analysis of FORACS/Dabob Bay data for the following equipments:

a. AN/SQS-23/23C series sonar.

b. Gyrocompass MK 19 Mod 3.

c. Gyrocompass MK 11 Mod 6.

d. Surface Search Radar AN/SPS-10//SPA-4 Indicator.

The recommended standards were submitted to MASWP[24].

2. Support for Project D/S 395, an evaluation of revised calibration and alignment procedures for sonar AN/SQS-23. The project extended from 27 January through 25 February 1966 and utilized the services of USS REEVES (DLG 24). The evaluation included:

a. Four FORACS tests.

b. System grooming and application of revised calibration and alignment procedures following first FORACS test.

c. Stability measurements by FORACS testing, by daily internal measurements of range and bearing accuracy using Test Set TS-1222, and by daily measurements of preamplifier phase shifts.

d. Source level, receiving sensitivity, and self-noise measurements.

e. Three days of operation with AN/SQQ-18 transponder buoy, to evaluate procedures prepared for its use by NEL, and to compare results with those obtained from FORACS.

The final report on Project D/S 395 was reviewed by SCASG early in July 1966[25].

3. Defining the requirements for a complete and effective sonar calibration and alignment program. These were set forth in both the Phase I and Phase II reports of SCASG[22,23]. These requirements are reproduced in Section 2 of this PMP.

SCASG was established to review, study, and provide information on the entire problem area of sonar calibration and alignment. There was no authority given to initiate action; only to recommend where action was required. In addition to establishing the requirements for a complete sonar alignment and calibration program, a total of fifty-four specific recommendations were made in the Phase I

and II reports[22,23]. A program of sonar system calibration and alignment evaluation, the subject of this PMP, is derived from the SCASG recommendations.

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18. BUSHIPS conf ltr ser 689B-015 dtd 7 February 1964: "FORACS; Establishment of Two Additional Sites During FY 64; Request for Authorization."

19. CNO conf ltr ser 062P32 dtd 12 February 1964: "FORACS; Establishment of Two Additional Sites During FY 64."

20. CNO conf ltr ser 0020P32 dtd 12 March 1965: "Standard Fleet Sonar Calibration and Alignment Procedures; Requirements for."

21. MASWSP conf ltr ser 05048 dtd 15 April 1965: "Sonar Calibration and Alignment Study Group; Establishment of."

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23. "Sonar Calibration and Alignment Study Group, Sonar AN/SQS-29 through 32C Series, including VDS: dtd 27 October 1965 (Conf.).

24. Chairman SCASG conf ltr ser 26998 dtd 14 June 1966: "Sensor Accuracy Standards."

25. NEL conf report 1378 dtd 24 May 1966: "CNO Project D/S 395 (u), Evaluation of Revised AN/SQS-23, -23A Maintenance Standard Book and AN/SQQ-18A Transponder Buoy Procedures."

SECTION 2

CURRENT REQUIREMENTS/OBJECTIVES

A. INTRODUCTION

The Chief of Naval Operations requested that MASWSP review the sonar calibration and alignment area with the objectives of establishing a Fleet-wide calibration and alignment program[1/*]. Specific areas highlighted by the CNO were: accuracy standards, standard alignment and calibration procedures, and the establishment of a calibration and alignment cycle. Also requested was a review of any other area necessary to accomplish the objective. In response to the CNO request, MASWSP established the Sonar Calibration and Alignment Study Group (SCASG) in April of 1965 and assigned to this committee the general task of conducting a technical review of the entire problem area[2/]. The importance of early solutions to problems in the sonar calibration and alignment area was stressed in CNO letters of March and June of 1966[3,4/].

B. REQUIREMENTS

SCASG determined that the requirements for a complete and effective sonar calibration and alignment program are:

1. Realistic standards.

2. Adequate and proved procedures that will achieve these standards.

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*Numbers refer to Bibliography.

3. Adequate test equipment for accomplishing these procedures (including transponder buoys).

4. Uniform and well-defined requirements for shipyard overhaul of sonars.

5. Data on which to base a realistic alignment and calibration cycle.

6. Test facilities to confirm that the standards are being met.

7. The necessary technical and management information feedback to assure that the program objectives are being achieved and to update the program as experience in its application is accumulated.

8. Sonar calibration and alignment should include a consideration of all sonar performance parameters, namely source level or output power in the water, receiver performance including receiving sensitivity and minimum detectable signal, sonar self-noise, and range and bearing accuracy including transmission to fire control.

C. OBJECTIVES

The achievement of the following specific objectives will result in a calibration and alignment program to meet the above requirements:

1. EVALUATION - To plan, implement, and analyze data from sonar system tests in order to:

a. Provide validated alignment documentation to the Fleet (standards and procedures).

b. Establish sonar calibration and alignment cycles based on equipment stability.

c. Provide feedback for system requirements, design, and effectiveness.

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2. MASWSP conf ltr ser 05048 dtd 15 April 1965: "Sonar Calibration and Alignment Study Group; Establishment of."

3. CNO ltr Ser 048P32, dated 12 March 1966, Sonar Alignment and Calibration Program.

4. CNO ltr Ser 056P95, dated 16 June 1966, Sonar Alignment and Calibration Program (u).

SECTION 3

SUMMARY HIGHLIGHTS

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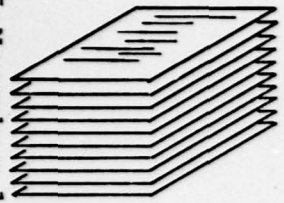
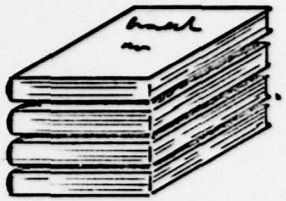
OPNAV REPORT SYMBOL 3910-3

1. IDENTIFICATION AND PICTURE

SONAR SYSTEM CALIBRATION AND ALIGNMENT EVALUATION PROGRAM

15 November 1966





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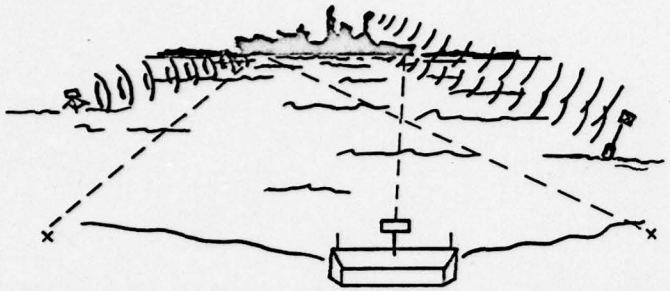

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2. DESCRIPTIVE HIGHLIGHTS

Establish calibration and alignment evaluation program for existing and future sonar systems.

Develop: accuracy standards, standard alignment and calibration procedures, uniform sonar overhaul requirements, technical facility requirements, calibration and alignment cycle, data analysis techniques and reporting system for effective feedback of technical and management information.

LEGEND:

A. Plan & Test

B. Evaluation

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System 3.			|A | B |					
System n	One system every six months.							

5. LEAD BUREAU: NAVSHIPS

6. TECHNICAL DIRECTOR: NAVSHIPS

7. PRINCIPAL CONTRACTORS: APL

4. RDT & E FUNDING (000)000)		FY 67 (and prior)	FY 68 (current)	FY 69 (budget)	FY 70	FY 71	FY 72	FY 73	TO COMPLETE
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2. PREPARATION FOR T&E (SONAR SYSTEM A)	0							
3. START TEST AND EVALUATION (SONAR SYSTEM A)	0							
4. PLANNING (SONAR SYSTEM B)	0							
5. END TEST AND EVALUATION (SONAR SYSTEM A)		0						
6. START PLANNING (SONAR SYSTEM C)		0						
7. PROMULGATION OF T&E RESULTS (SONAR SYSTEM A)		0						
8. END PLANNING (SONAR SYSTEM C)		0						
9. START PREPARATION FOR T & E (SONAR SYSTEM B)		0						
10. START TEST AND EVALUATION (SONAR SYSTEM B)		0						
11. END TEST AND EVALUATION (SONAR SYSTEM B)		0						
12. PREPARATION FOR T & E (SONAR SYSTEM C)		0						
13. PROMULGATION OF T & E RESULTS (SONAR SYSTEM B)			0					
14. START TEST AND EVALUATION (SONAR SYSTEM C)			0					
15. END TEST AND EVALUATION (SONAR SYSTEM C)			0					
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3. PREPARATION FOR T & E (SONAR SYSTEM A)									0			
4. START TEST AND EVALUATION (SONAR SYSTEM A)										0		
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SECTION 4

PROGRAM DESCRIPTION

A. ILLUSTRATION OF PROGRAM

The Sonar System Calibration and Alignment Evaluation Program consists of two major sub-programs; the Test and Evaluation Sub-Program and the Measurement Sub-Program.

1. Test and Evaluation: This sub-program is illustrated in Figure 4-1. The end products desired are (1) realistic performance standards, (2) adequate and proven procedures that will achieve these standards, and (3) establishment of realistic alignment/calibration and testing cycles. These products are essential to a total Navy-wide program to improve and maintain the accuracy of Fleet sonar systems. The knowledge gained through a planned program of evaluation will also provide feedback information pointing to needed improvements in sonar system design, documentation and support.

2. Measurement: This sub-program supports the evaluation program by ensuring that measurement facilities are instrumented, and operated in such a manner that technical excellence of data is achieved. The relationship between the sub-program and the measurement facilities is illustrated in Figure 4-2.

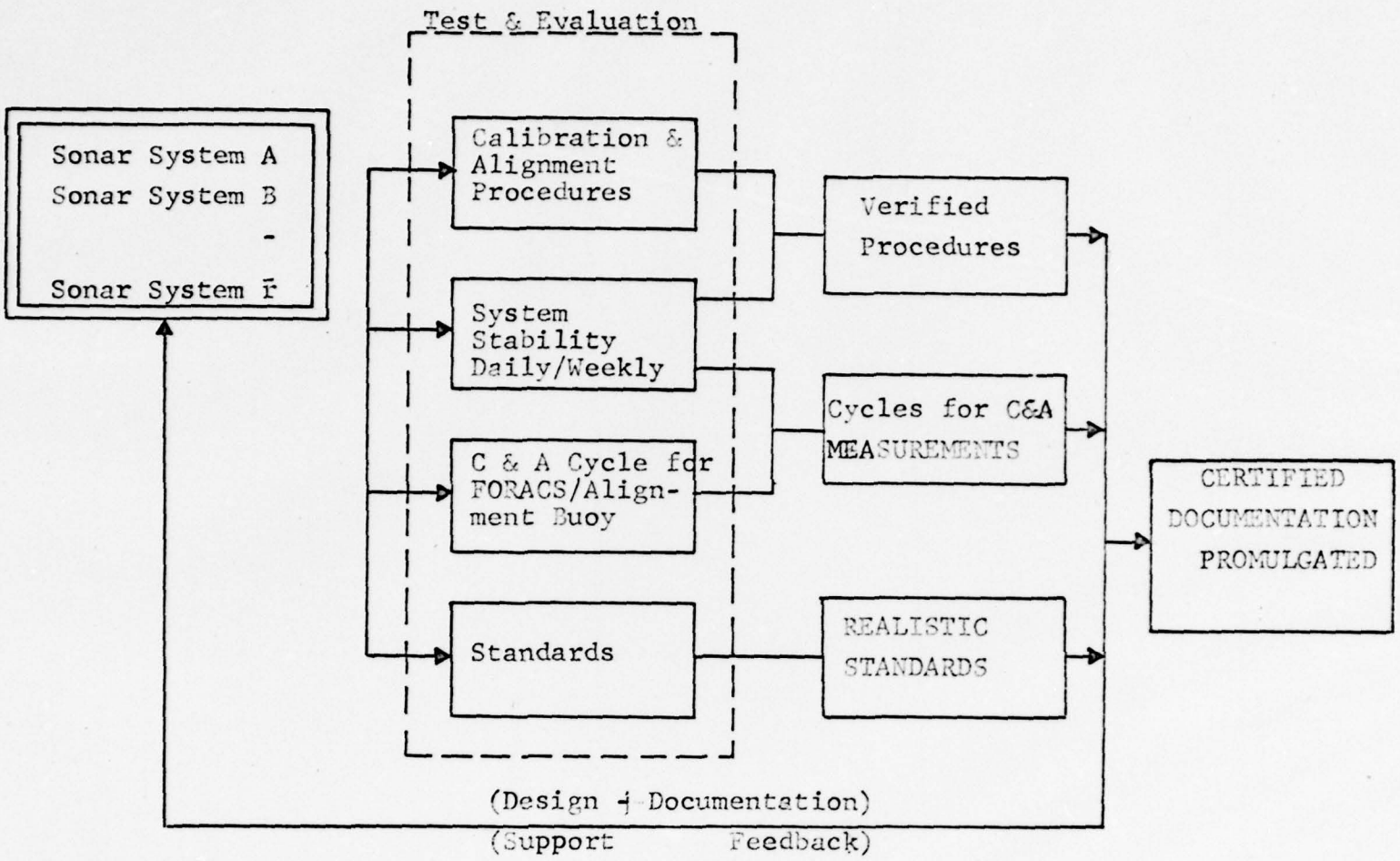


Figure 4-1. Test and Evaluation Sub-Program.

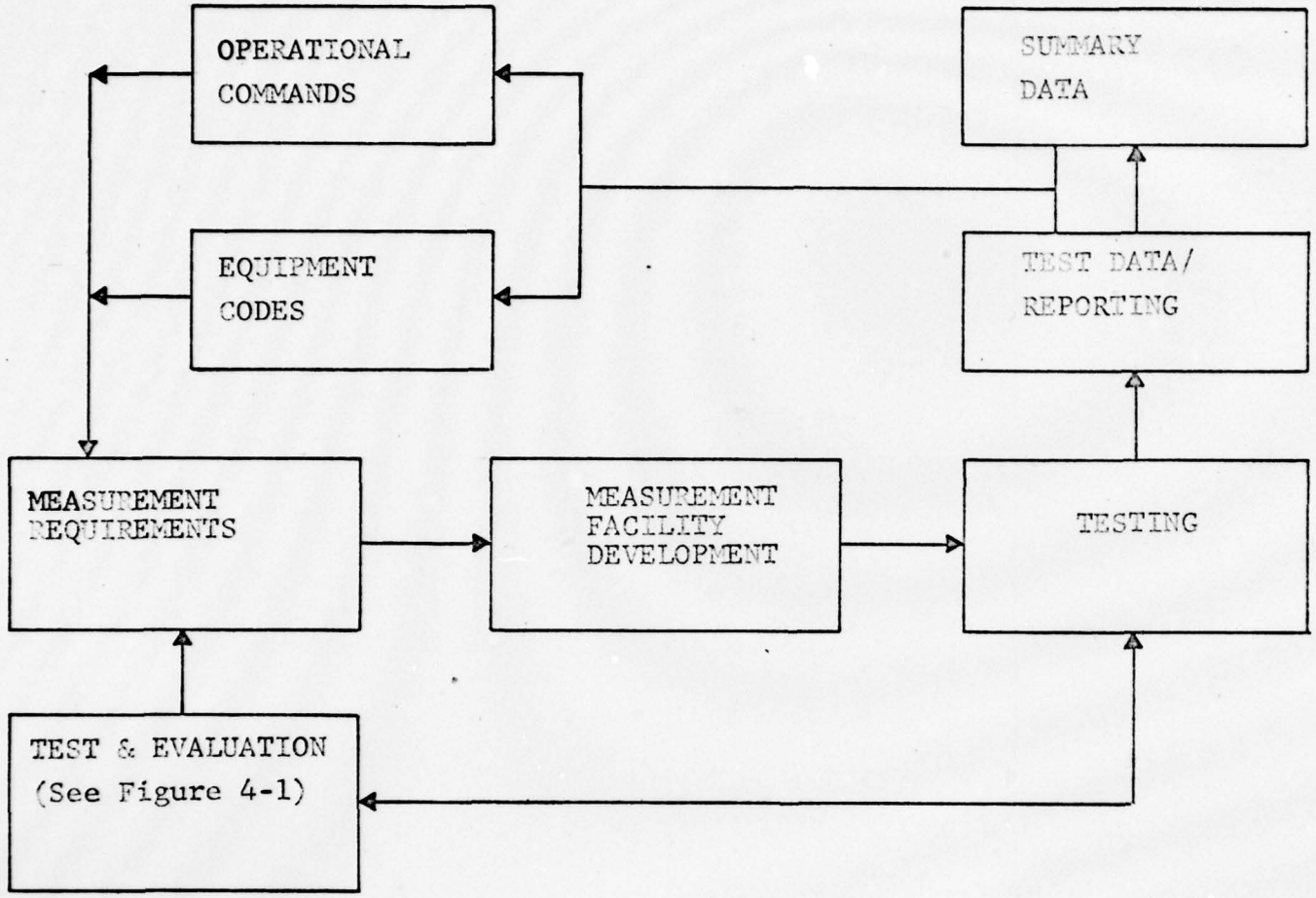


Figure 4-2. Measurement Sub-Program

B. DESCRIPTION OF THE PROGRAM

1. Test and Evaluation: The test and evaluation subprogram for sonar system alignment and calibration will provide approved standards, procedures and cycles for Fleet sonar systems. The evaluation for each system will be accomplished through a planned and fully controlled test program consisting of four basic parts: (1) Procedures Evaluation, (2) System Stability Evaluation, (3) Evaluation to Establish Testing Cycle, and (4) Evaluation to Establish Standards.

Testing will be performed at measurement facilities such as FORACS, Dabob Bay, St. Croix, and AUTEC.

a. Procedure Test and Evaluation: The objective of this phase of the program is to provide adequate and proven procedures for sonar alignment and calibration. The basic question to be answered is: will application of a given set of procedures result in acceptable alignment and calibration of the sonar? That is, will the sonar meet the established accuracy standards? A series of tests will be performed on several ships thus providing a statistical (realistically limited) basis for proof of procedures. The procedures will be applied to each sonar. Thorough testing will follow to determine the results achieved. Procedures will be modified if initial test results indicate deficiencies. Overall evaluation for all ships tested will provide the basis for validation of the procedures.

b. Stability Test and Evaluation: The stability evaluation portion of the program will provide data required to establish a realistic alignment and calibration cycle. Procedures will be applied to a single sonar. A series of daily and weekly tests will follow to determine the stability of the system. This process will be repeated for a sample of sonar equipments sufficient in number to satisfy statistical requirements.

c. Evaluation to Establish Testing Cycle: Cycle requirements for FORACS/Alignment Buoy Checks will be determined by this phase of the program. Procedures will be applied to a single sonar and the system tested. Alignment and calibration will then be maintained by ship's force for an extended period of time using the same procedures. The ship will then be retested to determine system degradation, if any. Reapplication of procedures will be made at this point in time to determine if ship's force has maintained proper alignment and calibration. The process will be repeated for other ships and may be repeated for the same ship. Time intervals between testing will be varied.

d. Test and Evaluation to Develop Standards: Realistic sonar standards will be developed from measured performance data on many ships. Alignment and calibration procedures will be applied to each sonar system prior to testing at a measurement range.

Two groups will be established. The first will be a control group in which "grooming" is performed through application of procedures by engineering personnel assigned to the evaluation program. The second will have procedures applied by ship's force. Overall evaluation of the results from many tests will provide a solid foundation for setting realistic standards.

The separate portions of the total evaluation program are interrelated. For example, system stability evaluation will provide information that may relate to the adequacy of procedures as well as the requirements for a testing cycle. Similarly although the procedures evaluation portion of the program will validate the technical adequacy of the procedures, the use of these procedures by ship's force in the standards and cycle portion of the program may reveal deficiencies in the understandability of the written material. Thus, the various portions of the program will be conducted concurrently, or nearly so, with interchange of information where applicable. A given ship, in general, will be involved in more than one phase of the overall program.

2. Measurements: The measurements portion of the program will ensure that facilities yield data of the quality required for system evaluation.

a. Facility Development/Expansion: The evaluation program will contribute to the determination of requirements for measurement facilities. These contri-

butions will include: (1) parameters to be measured, (2) required accuracy of measurements, (3) sizes and distribution of data samples required, (4) standards for system to be measured, and (5) development of special equipment.

b. Testing: For evaluation tests where new techniques are involved, a test director will be provided to ensure that the test plan or technique is understood and that valid data are obtained. Engineering assistance for systems under test will also be provided from the test and evaluation portion of the test plan. Plans will include these requirements for approval by the cognizant system Project Office/Division Director.

c. Test Reporting: Except for special tests not normally conducted by a facility, individual tests (such as standard FORACS reports) will be reported by the facility. In addition, all facility test data will be summarized and promulgated. These reports will serve as feedbacks to the operational commands and equipment codes.

C. PROGRAM LIAISON

1. Overall Program: Figure 4-3 illustrates the operational flow of information and indicates the magnitude of the overall program liaison effort. The central point of contact within the material commands is Naval Ship Systems Command (NAVSHIPS) code 1622, SONAR TECHNOLOGY. Liaison outside the material commands is as follows:

a. CNO Fleet Operational Commands: Operational requirements and Fleet services must be obtained. Restriction of documentation usage to that certified by the program must be ensured. In addition, feedback on effectiveness of documentation and reports must be maintained and program status must be reported to these commands.

b. Laboratories: Test requirements, test plan approval, and test support must be obtained from the appropriate system project offices. Statistics, evaluation results, and reports must be promulgated to appropriate recipients. In addition, program findings and task assignment must be maintained.

c. Ranges: Tests must be scheduled with appropriate operations. Requirements for support, test planning, and test direction must be met. Constant awareness of any change in range capability must be maintained.

2. Material Commands: Figure 4-4 shows the sonar system calibration and alignment liaison within the material commands. Program management for Sonar System

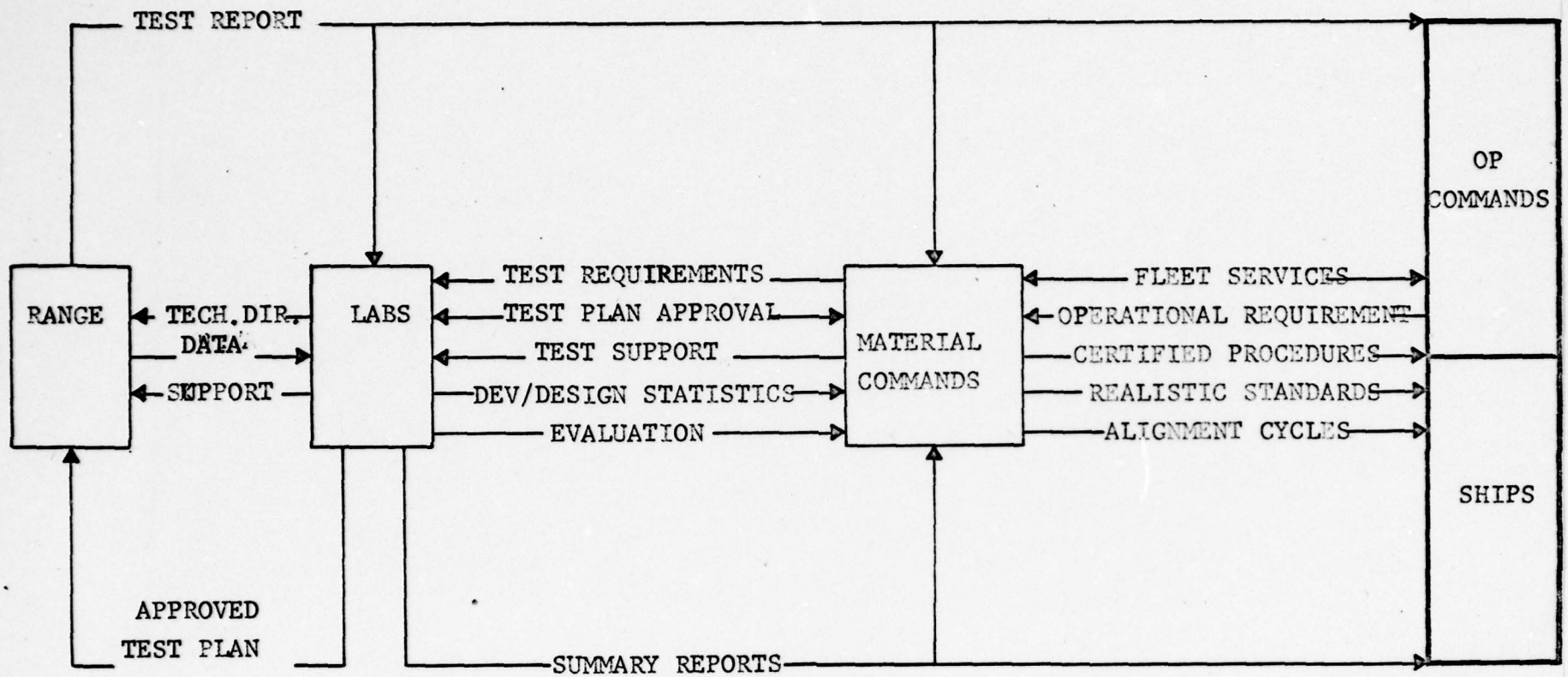


Figure 4-3. Sonar Alignment and Calibration Evaluation Program Operational Flow.

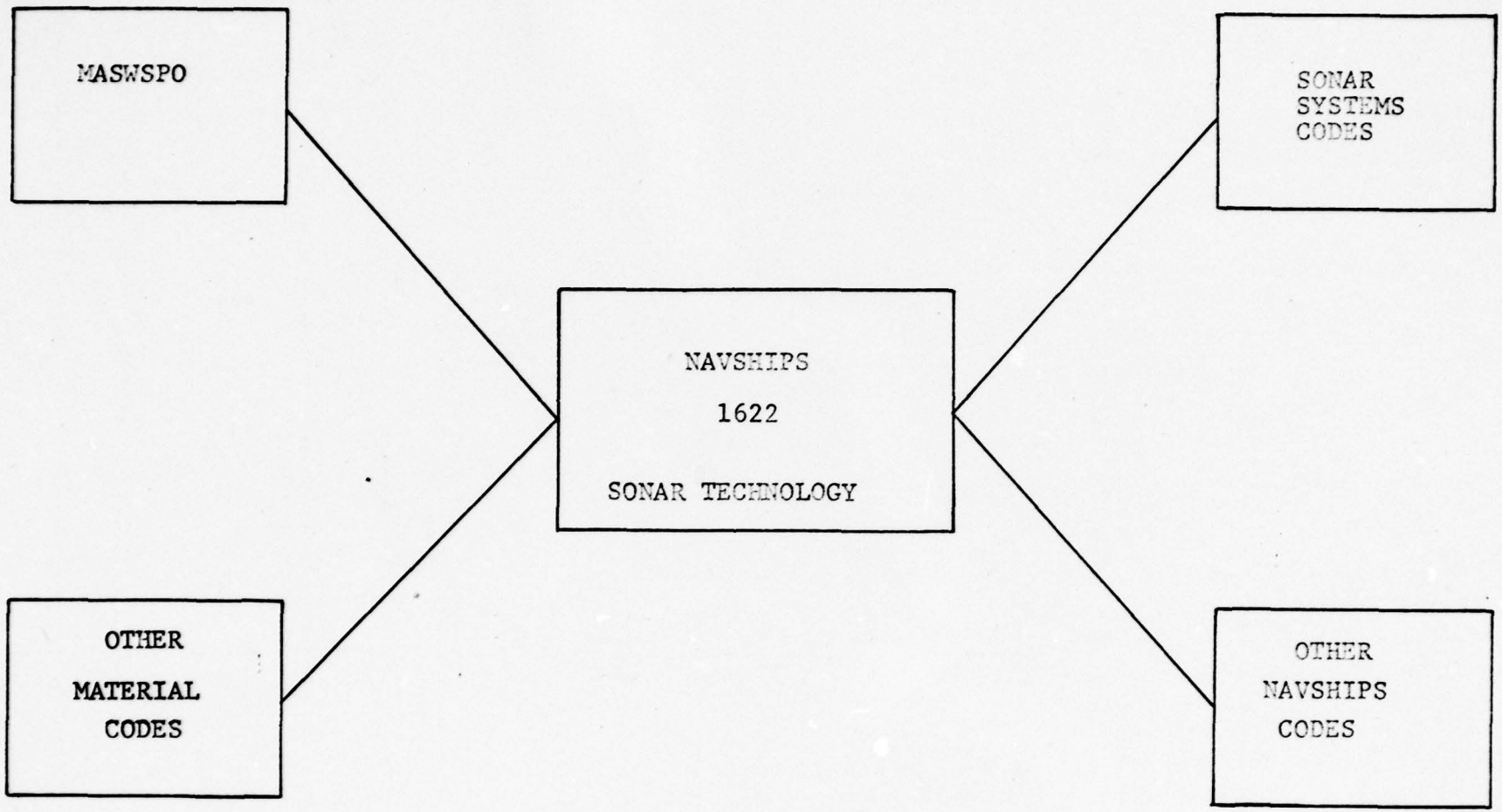


Figure 4-4. Liaison Within Material Commands.

Calibration and Alignment Evaluation rests with NAVSHIPS code 1622. Working relationships with other offices are as follows:

a. Sonar Systems Codes: The program recognizes the fact that the overall responsibility for system performance, including alignment and calibration, rests with the cognizant Division Directors/Project Offices. However, this program will ensure a standardization of sonar alignment and calibration capability and documentation not previously realized, and will reduce, but not eliminate, the tasks of the Division Director/Project Office who must still: (1) Provide accuracy specifications, (2) Provide alignment and calibration procedures for evaluation, (3) Approve test and evaluation plans, (4) Provide engineering assistance for the tests, and (5) Promulgate certified calibration and alignment documentation to the Fleet.

b. Manager, Anti-Submarine Warfare Systems Projects Office: In addition to normal channels, close liaison with Manager, Anti-Submarine Warfare Systems Project (MASWSP) will be maintained through joint representation on an Anti-Submarine Warfare (ASW) System Calibration and Alignment Advisory Committee.

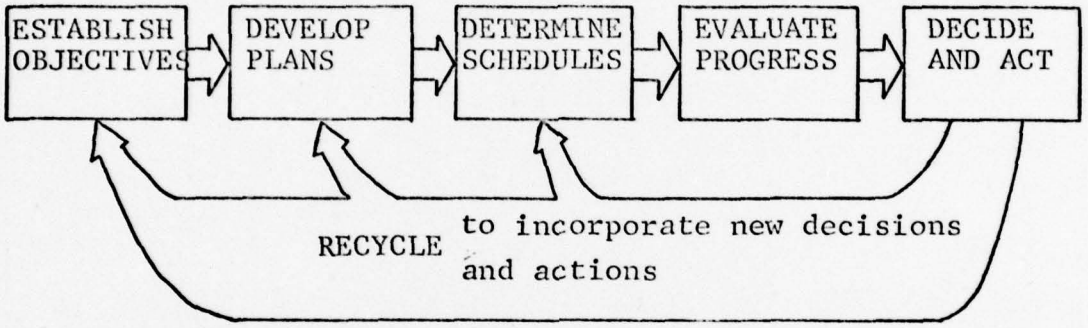
c. Other Material Codes: Close liaison must be maintained between NAVSHIPS 1622 and other Material Commands Codes that have cognizance over either ASW sensors or ASW ranges.

d. Other NAVSHIPS Codes: Close liaison will have to be maintained with several sensor codes due to the inherent involvement of those sensors in all calibration and alignment measurements and analysis. It should be noted that test reports, summary data, standard updates, etc., will include all sensors measured at designated ASW ranges. Another area in which a close working relationship must be established and maintained is Planned Maintenance System documentation. Maintenance record cards must be based on certified calibration and alignment documentation. The issuance updating of these cards must, therefore, be coordinated with test and evaluation efforts. Finally, a close working relationship will have to be maintained with several NAVSHIPS activities such as EMEC and various laboratory groups.

SECTION 5

MANAGEMENT PLAN

The management process cycle, as depicted by the PERT Guide and shown below will be followed:



Section 5 contains the following subsections:

A. Management Lines of Authority and Responsibility

B. Program Management Organization

C. Management Control

D. Work Break-down Structure

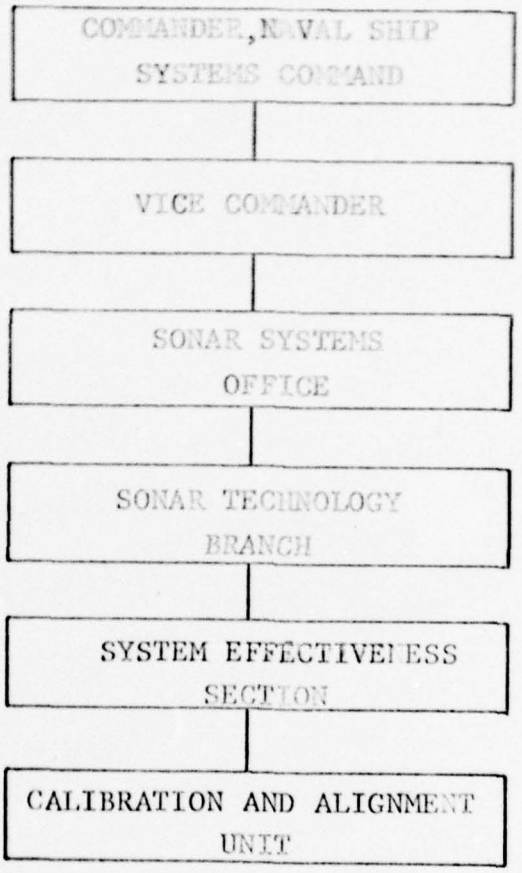
E. Top Level Network

F. Responsibility Matrix

G. Security

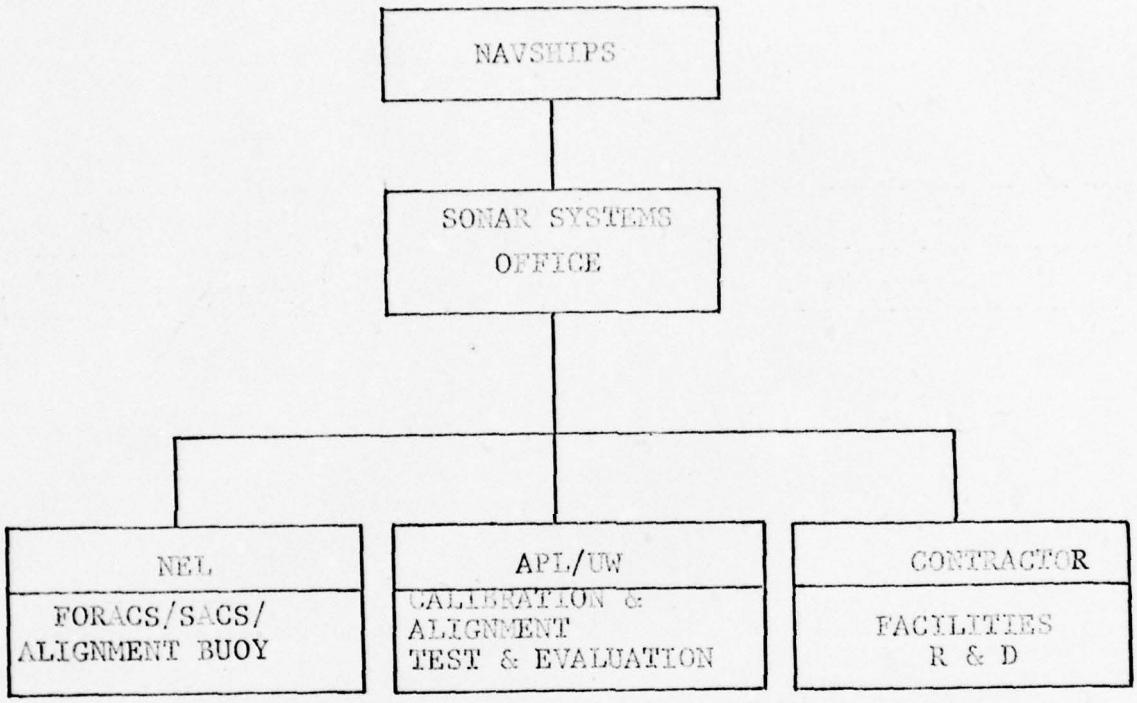
Sub-Section 5-A

MANAGEMENT LINES OF AUTHORITY AND RESPONSIBILITY



Sub-Section 5-B

PROGRAM MANAGEMENT ORGANIZATION



Sub-Section 5-C

MANAGEMENT CONTROL SYSTEM

1. Test and Evaluation

Periodic progress reports from APL/UW will include this item. The primary reporting however, will be through the normal work cycle as follows:

a. Test plan submission for approval

b. Requests for support

c. Individual test reports

d. Final Evaluation Report

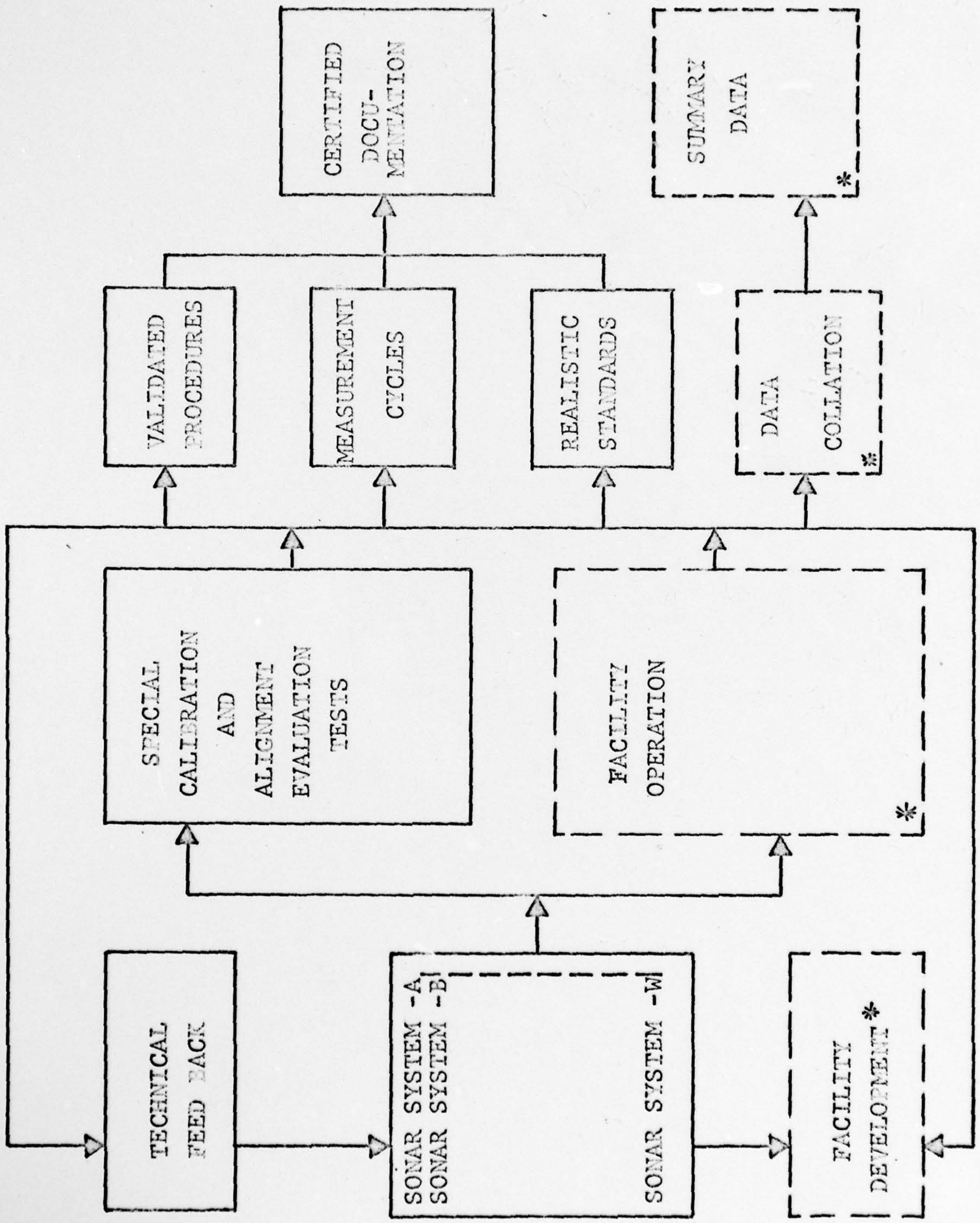
Section 5-D

WORK BREAKDOWN STRUCTURE

LEVEL ZERO	LEVEL ONE	LEVEL TWO	LEVEL THREE
Sonar System Calibration and Alignment Evaluation Program	TEST AND EVALUATION	TEST PLANNING	PROCEDURES SURVEYED
			PROCEDURES UPDATED
			PERFORMANCE DATA SURVEYED
			OVERALL PLAN PREPARED
			SUPPORT AND APPROVAL REQUESTED
		TEST PREPARATION	SUPPORT AND APPROVAL GRANTED
			FACILITIES SELECTED
			DETAILED PLANS FORMULATED
			TENTATIVE PROCEDURES ADOPTED
			TENTATIVE STANDARDS ADOPTED
		TESTS AND EVALUATION	PROCEDURES/STABILITY TEST SHIPS 1 & 2
			STABILITY EVALUATION SHIPS 1 & 2
			STABILITY TESTS AS REQUIRED
			PROCEDURES/1st CYCLE SHIPS 3-n
			REVIEW PROCEDURES WITH SHIPS
			PROCEDURES PRE-FORACS C & A
			STANDARDS TESTS COMMENCE
			PROCEDURES/2nd CYCLE SHIPS 3-n
			PRELIM.EVAL. PROCEDURES/CYCLES
			PROCEDURES/3rd CYCLE SHIPS 3-n
			PROCEDURES/4th CYCLE SHIPS 3-n
			FINAL EVAL. PROCEDURES/CYCLE
			DEV. OF STANDARDS FROM ALL DATA
			SSO REVIEW
			SSO APPROVAL
			PROCEDURES PROMULGATED
			MEASUREMENT CYCLE PROMULGATED
			STANDARDS PROMULGATED
			STANDARDS REVIEWED/UPDATED
			STANDARDS HANDBOOK REISSUED
		INTERIM EVALUATION	STANDARDS DEVELOPED SQS-23
			STANDARDS DEVELOPED SQS-29-32
			STANDARDS DEVELOPED BQR-2B
			STANDARDS DEVELOPED SQS-26
			STANDARDS DEVELOPED BQS-6
			LETTER PROMULGATION
			HAND BOOK PROMULGATED
			SQS-23 PROCEDURES EVALUATED
			SQS-23 CHANGE PAGES PROMULGATED

SONAR SYSTEM CALIBRATION AND ALIGNMENT EVALUATION PROGRAM

TOP LEVEL NETWORK



* Not Part of This Program

Sub-Section 5-F

RESPONSIBILITY MATRIX

WORK BREAKDOWN STRUCTURE ITEM	WBS LEVEL	NAVSHIPS 1622		NEL	APL/ VW	Cog.Sys CODE	
TEST & EVALUATION	1	X			X	X	
TEST PLANNING	2	X			X		
TEST PREPARATION	2	X			X	X	
TEST & EVALUATION	2	X			X	X	
PROMULGATION	2	X				X	
INTERIM EVAL.	2	X		X	X	X	

Sub-Section 5-G

SECURITY

1. Measurement Reports

Measurement Reports of accuracy and performance of ship's equipment issued from the various facilities will require CONFIDENTIAL classification, with downgrading at three year intervals and declassification after twelve years.

2. Summary Reports

Summary Reports indicating equipment or systems capability, operational readiness or weapons effectiveness must be considered for SECRET classification and will require a minimum classification of CONFIDENTIAL with downgrading at three year intervals and declassification after twelve years.

3. Reponsibility

NAVSHIPS Code 201 will have general security cognizance of the program with further responsibilities being defined by the issuance of DD 254's as required.

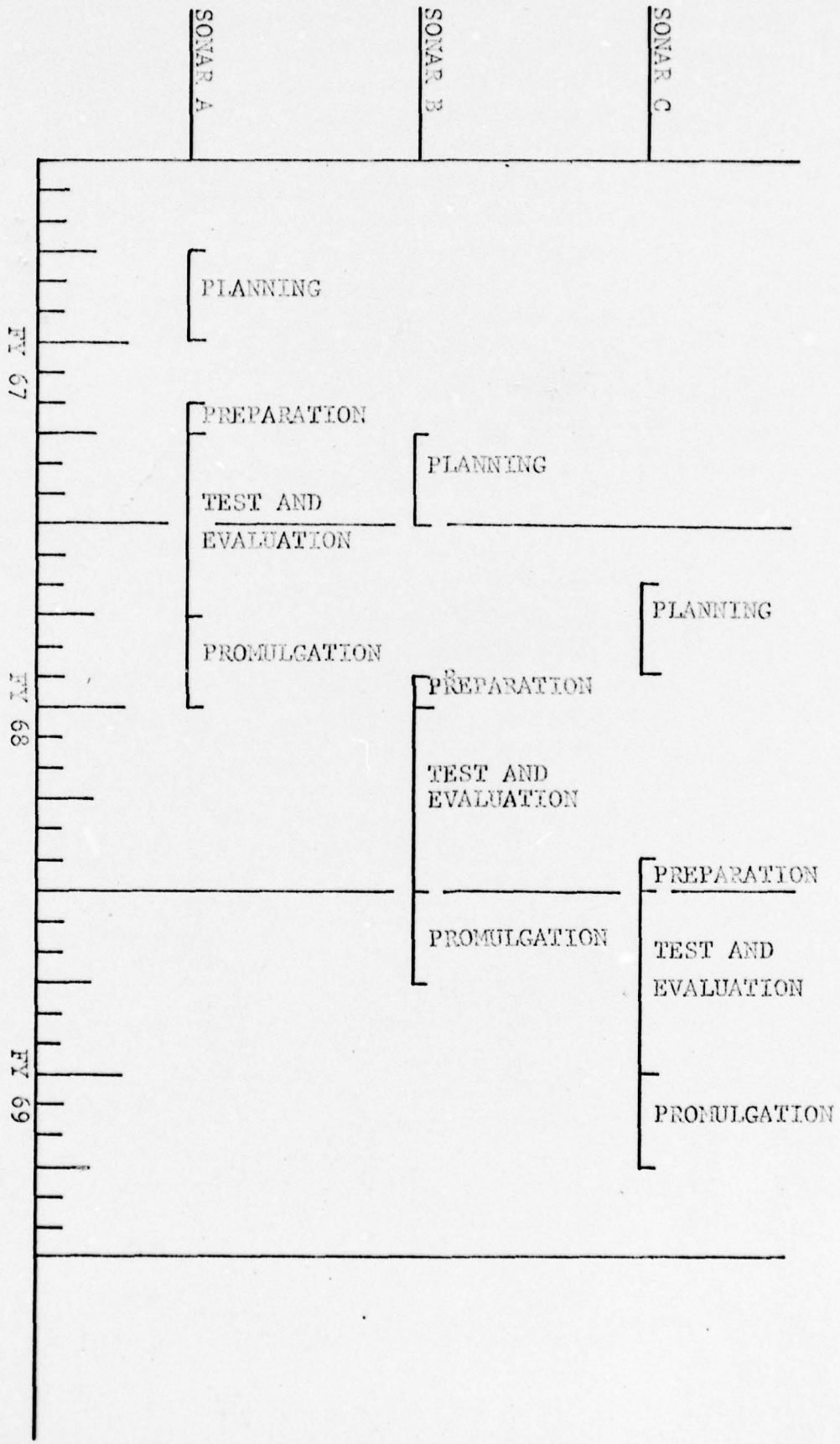
SECTION 6

MILESTONE PLAN

A. Test and Evaluation

Figure 6-1 illustrates a representative program for FY 67 through FY 69 with major milestones indicated. Three major sonar systems would be evaluated by the end of the third quarter FY 69. Testing of a fourth system (not shown) would commence about mid-69. Following evaluation of the first two sonar systems, the rate is expected to be one system evaluation completed every six month period. Overlapping of system planning and testing will be required. It is emphasized that times are tentative and may vary as a result of knowledge gained as the program progresses as well as size/complexity of each system. Also, in order to maintain the type of schedule shown in Figure 6-1, procedures, ship services, and other support must be available when required.

Pages 6-3 through 6-7 provide a list of events typical of a test and evaluation plan for a single sonar system.


SONAR A
SONAR B
SONAR C
FY 67
FY 68
FY 69
PLANNING
PREPARATION
TEST AND EVALUATION
PROMULGATION
PLANNING
PREPARATION
TEST AND EVALUATION
PROMULGATION
PLANNING
PREPARATION
TEST AND EVALUATION
PROMULGATION

SONAR SYSTEM CALIBRATION & ALIGNMENT EVALUATION NAVSHIPS 1622	MAJOR EVENTS	FY67	FY68	FY69	FY70	FY71	FY72	FY73	FY74	REMARKS
	1. TEST PLANNING									
	2. TEST PREPARATION									
	3. TEST & EVAL.									
	4. PROMULGATION									
	5. INTERIM EVAL.									

ACTION MILESTONES		EST. START	ACT. START	EST. COMPLETE	ACT. COMPLETE
1 TEST PLANNING	a. PROCEDURES SURVEYED				
	b. PROCEDURES UPDATED				
	c. PERFORMANCE DATA SURVEYED				
	d. OVERALL PLAN PREPARED				
	e. SUPPORT AND APPROVAL REQUEST.				
2. TEST PREPARATION	a. SUPPORT AND APPROVAL GRANTED				
	b. FACILITIES SELECTED				
	c. DETAILED PLANS FORMULATED				
	d. TENTATIVE PROCEDURES ADOPTED				
	e. TENTATIVE STANDARDS ADOPTED				

SAMPLE MILESTONE ITEMS
ACTUAL DATES PROVIDED
FOR EACH TEST

ITEM: TEST AND EVALUATION LEVEL: 1 EFFECTIVE DATE: 10-1-66

PROGRAM MILESTONE PLAN

15 November 1966

SONAR SYSTEM CALIBRATION & ALIGNMENT EVALUATION	MAJOR EVENTS	FY67	FY68	FY69	FY70	FY71	FY72	FY73	FY74	

3. TESTS AND EVALUATION	a. PROCEDURES/STABILITY TEST - SHIPS 1 & 2				
	b. STABILITY EVALUATION - SHIPS 1&2				
	c. STABILITY TESTS AS REQUIRED				
	d. PROCEDURES/1st CYCLE - SHIPS 3-n				
	e. REVIEW PROCEDURES WITH SHIPS				
	f. PROCEDURES PRE-FORACS C & A				
	g. STANDARDS TESTS COMMENCE				
	h. PROCEDURES/2nd CYCLE - SHIPS 3-n				
	i. PRELIM. EVAL. PROCEDURES/CYCLE				
	j. PROCEDURES/3rd CYCLE - SHIPS 3-n				
	k. PROCEDURES/4th CYCLE - SHIPS 3-n				

SAMPLE MILESTONE ITEMS
ACTUAL DATES PROVIDED
FOR EACH TEST

PROGRAM MILESTONE PLAN

SONAR SYSTEM CALIBARTION & ALIGNMENT EVALUATION	MAJOR EVENTS	FY67	FY68	FY69	FY70	FY71	FY72	FY73	FY74	REMARKS
	1. TEST PLANNING									
	2. TEST PREPARATION									
	3. TEST & EVAL.									
	4. PROMULGATION									
	5. INTERIM EVAL.									

ACTION MILESTONES		EST. START	ACT. START	EST. COMPLETE	ACT. COMPLETE
	1. FINAL EVAL. PROCEDURES/CYCLE				
	m. DEV. OF STANDARDS FROM ALL DATA				
4. PROMULGATION	a. SSO REVIEW				
	b. SSO APPROVAL				
	c. PROCEDURES PROMULGATED				
	d. MEASUREMENT CYCLE PROMULGATED				
	e. STANDARDS PROMULGATED				
	f. STANDARDS REVIEWED/UPDATED				
	g. STANDARDS HANDBOOK REISSUED				

SAMPLE MILESTONE ITEMS
ACTUAL DATES PROVIDED
FOR EACH TEST

ITEM: TEST AND EVALUATION

LEVEL 1

EFFECTIVE DATE: 10-1-66

PROGRAM MILESTONE PLAN

SONAR SYSTEM CALIBRATION & ALIGNMENT EVALUATION	MAJOR EVENTS	FY67	FY68	FY69	FY70	FY71	FY72	FY73	FY74	REMARKS
	1. TEST PLANNING									
	2. TEST PREPARATION									
	3. TESTS & EVAL.									
	4. PROMULGATION									
	5. INTERIM EVAL.									

ACTION MILESTONES		EST. START	ACT. START	EST. COMPLETE	ACT. COMPLETE
5. INTERIM EVALUATION	a. STANDARDS DEVELOPED SQS-23		6-66	9-66	10-66
	b. STANDARDS DEVELOPED SQS-29-32		9-66	11-66	
	c. STANDARDS DEVELOPED BQR-2B		9-66	11-66	
	d. STANDARDS DEVELOPED SQS-26		11-66	12-66	
	e. STANDARDS DEVELOPED BQS-6		11-66	12-66	
	f. LETTER PROMULGATION			1-67	
	g. HAND BOOK PROMULGATED			3-67	
	h. SQS-23 PROCEDURES EVALUATED		3-66	12-66	
	i. SQS-23 CHANGE PAGES PROMULGATED			1-67	

ITEM: TEST AND EVALUATION LEVEL: 1 EFFECTIVE DATE: 10-1-66

PROGRAM MILESTONE PLAN

SONAR SYSTEM CALIBRATION & ALIGNMENT EVALUATION	MAJOR EVENTS	FY67	FY68	FY69	FY70	FY71	FY72	FY73	FY74	REMARKS
	1. INTERIM SUMMARY									
	2. PERMANENT SUMMARY									

ACTION MILESTONES		EST. START	ACT. START	EST. COMPLETE	ACT. COMPLETE
1. INTERIM	a. PRELIMINARY REPORT			12-66	
SUMMARY	b. REVIEW COMMENTS	12-66		1-67	
2. PERMANENT	a. FINALIZE FORMATS			1-67	
SUMMARY	b. ESTABLISH TECHNIQUES			2-67	
	c. FIRST SUMMARY REPORT				
				3-67	

ITEM; DATA SUMMARIZATION

LEVEL: 1 EFFECTIVE DATE: 10-1-66

PROGRAM MILESTONE PLAN

SECTION 7

DEFINITION PLAN

The cost and complexity of this program does not justify utilization of the Project Definition Phase (PDP), and this approach is not being employed.

SECTION 8

TEST AND EVALUATION PLAN

A. TEST AND EVALUATION PLAN

The sonar system alignment and calibration test and evaluation program will provide approved procedures, alignment/calibration and test cycles, and standards for Fleet sonar systems. The program will be applied to new as well as old systems with priorities being established on the basis of number of systems and relative importance to total Fleet effectiveness. The introduction of future sonar systems and the continuing modification/improvement of existing systems dictate the need for a continued application of this program.

A detailed test and evaluation plan for a representative sonar system is illustrated in Figure 8-1. The representative system is the AN/SQS-23 TRAM. The test and evaluation plan will apply equally well to other sonar systems as indicated. The present three-year program to convert all AN/SQS-23/23C Series Sonars to TRAM modified sonars (23D through 23G), the large quantity of existing 23's, and the fact that this is a prime ASW sonar, point to the requirement for early evaluation of this system. It is logical to select the TRAM system as the first to undergo the test and evaluation program. The goal will

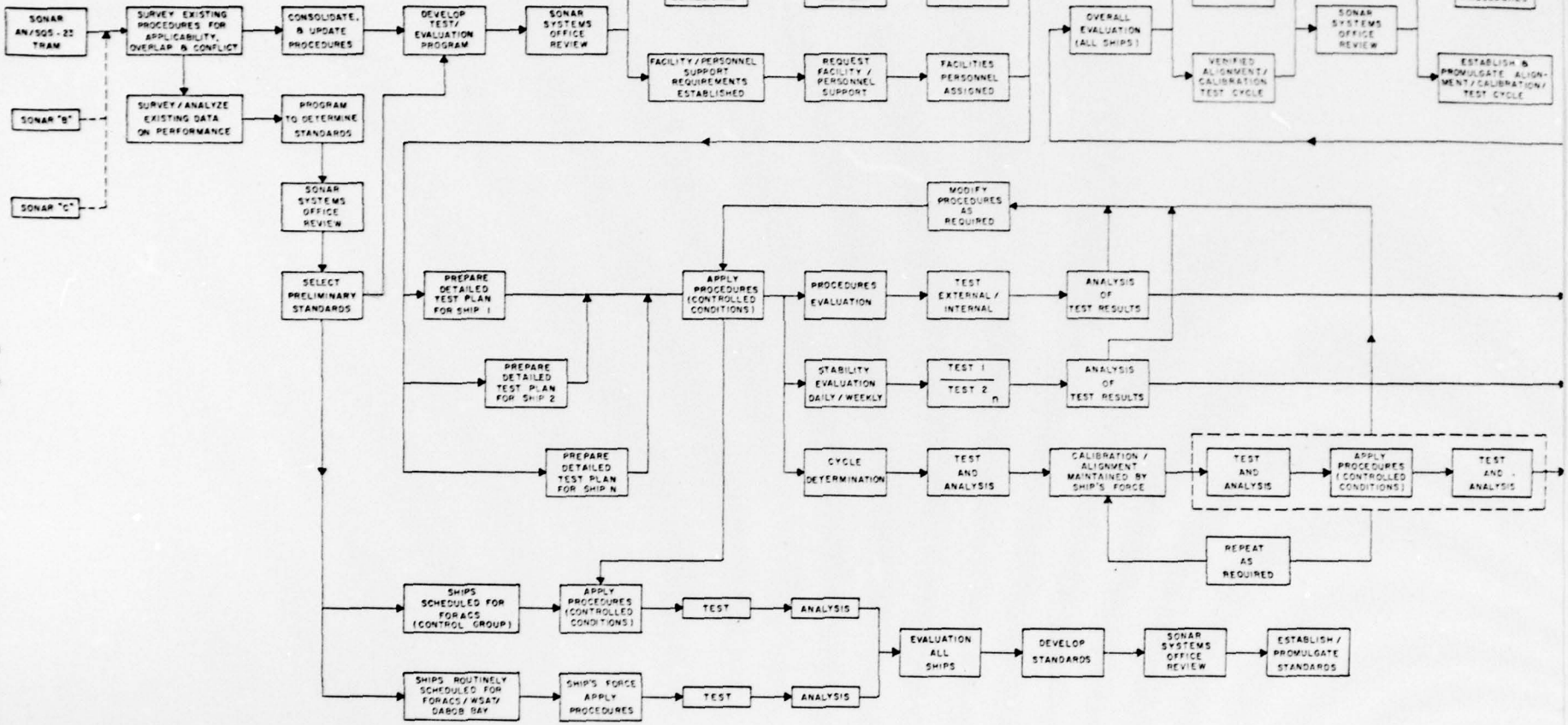


Figure 8-1. Representative Test and Evaluation Plan

be to provide approved procedures, cycles, and standards well before full Fleet installation is complete.

The first step in the test and evaluation plan for a given sonar will be to obtain all existing alignment and calibration procedures that may relate to that equipment, review the procedures for applicability, overlap, and conflict, and generate a single set of procedures to be evaluated. The single set of procedures may be further modified as a result of initial evaluation efforts; i.e., as knowledge is gained as to their completeness and correctness during initial tests. In the case of "older" equipments, many procedures are found to exist (manuals, MSB and MRC's, Type Commander instructions, individual shipyard procedures, own ship procedures), none of which have been adequately evaluated. The task here will be to review/collate these into a single set of procedures that reflect current state-of-the-art knowledge. In the case of TRAM, procedures provided will be updated, if required, to reflect the knowledge gained through current efforts such as Project DS/395 (project to evaluate alignment and calibration procedures for the Sonar AN/SQS-23A--single ship/single sonar employed).

Concomitant to the survey of existing procedures will be a survey of existing measured performance data. Evaluation of procedures implies a comparison of results obtained through application of those procedures with a set of standards. Are the procedures producing a desired result? Unfortunately, for many sonar systems today, realistic and adequately defined standards do not yet exist.

The purpose of the survey of existing performance data will be to generate preliminary standards to fill this void. It is emphasized that existing measurement data will not necessarily reflect the performance that can be achieved by proper application of verified alignment and calibration procedures. Thus, judgement must be used in the selection of preliminary standards. In certain instances, such standards may be used as an upper limit; i.e., the performance obtained as a result of the application of the procedures should be "better than" the preliminary standards.

Subsequent to the selection of procedures and preliminary standards, a test and evaluation program plan and a plan for the program to establish standards will be prepared for the specific sonar system. Each of the plans will be reviewed by the cognizant system Project Officer/ Division Director for approval. Decisions such as number of ships required for each phase of the evaluation, length of test periods, and facility/personnel support requirements will have been made during the preparation of these plans.

Following approval of the program plans, ship support and facilities/personnel support will be requested. Commencement of actual testing will depend upon ship availability. Requests for ship support will be submitted as early as practicable in order to minimize the time period between program planning and start of testing.

Detailed test plans will be prepared for each ship assigned to the program. The total test program for a system will consist of four basic parts: (1) Procedures

Evaluation, (2) System Stability Evaluation, (3) Evaluation to Establish Testing Cycle, and (4) Evaluation to Establish Standards. It is envisioned that a representative program may require, as a minimum, five ships for the first three parts of the test program. The evaluation to establish standards (part four) will be accomplished with a greater sample size; i.e., those ships schedules for FORACS as well as other measurement facilities. As scheduling permits, each of the five ships will be involved in more than one evaluation phase. The first ship, for example, could be sample number one for procedures evaluation, stability evaluation, and the cycle determination portions. It could also serve as sample number one of the control group for establishing standards. Procedures, of course, will be modified if initial test results indicate deficiencies. At some point in time, the procedures must be fixed. Hopefully, this would occur following the first or second ship. The evaluation of the "fixed" procedures would then proceed using the remaining test vehicles.

Stability evaluation will require daily and weekly controlled testing, both internal and external, for each ship involved in this phase of the program. Procedures will be applied prior to testing. Each ship will have to be assigned for a period of at least one month to obtain a realistic measure of stability. The results of the stability evaluation may indicate the necessity for modification of the procedures in the area of frequency of internal checks/adjustments. As in the case of procedures evaluation, hopefully, sufficient information would be

obtained after one or two ships to permit a logical modification of the procedures, if required. Stability evaluation would continue for the remaining ships using the "fixed" procedures. Rate of drift and magnitude of drift will be measured for the systems tested.

"Stability" in the case of AN/SQS-23 includes failure of front-end components. That is, a failed preamplifier produces an error on certain beams. We must have enough testing to insure that effects such as these are recognized.

The foregoing evaluation will provide needed data on "short term" stability of the system. However, the ability to maintain acceptable performance over an extended period of time must also be determined. Given a set of verified procedures, which will include routine internal checks/adjustments, can the system be maintained at peak performance? How often should external tests such as FORACS or alignment buoy tests be made? The plan for the cycle determination portion of the program will require each sample ship to be retested periodically with calibration/alignment being maintained by ship's force during the time interval between tests. Each retest will actually consist of three parts spanning a relatively short period of time: (1) test, (2) application of procedures by a test engineer, and (3) test. Part (1) will measure the performance of the system following maintenance of alignment and calibration by ship's force. Part (2) will determine the status of internal alignment/calibration, thus providing a check of ship's force work. Part (3) will measure performance following the reapplication of procedures and

will provide a measure of the significance of any deficiencies noted in part (2). The development of the overall test/evaluation program plan for a given system will establish the initial retest period. This may subsequently be varied depending upon knowledge gained as the program progresses.

The final evaluation of the results obtained from the procedures, stability, and cycle portions of the program will provide verified procedures, verified alignment and calibration cycle (internal), and verified testing cycle. These will be reviewed by the cognizant Project Officer/ Division Director for approval and promulgation.

The program to determine standards for a system will be conducted concurrently with the above portions of the program. Procedures will be applied by test engineers under controlled conditions to a selected sample of ships undergoing FORACS tests. This will be a control group. Procedures will be applied by ship's force to a second sample of ships undergoing routine tests at measurement facilities such as FORACS/St. Croix, and Dabob Bay. Standards will be developed from the evaluation of results for all ships tested. These will be subsequently reviewed and promulgated.

SECTION 9

PRODUCTION, INSTALLATION, AND BASE LOADING PLAN

A. PRODUCTION PLAN

There is no production involved in this program.

B. INSTALLATION PLAN

Facility installation is covered under the FORACS/SACS/ALIGNMENT BUOY MASTER PLAN. However, technical assistance, especially in the acoustics area, will be provided as required.

C. BASE LOADING PLAN

1. Test and Evaluation: A base loading plan does not apply to the test and evaluation portion of the program. Existing measurements facilities are considered capable of providing the required testing services with the expansion of measurement capability which is covered under the facilities portion.

2. Measurements: The base loading plan for facilities and data summarization is given in the FORACS/SACS/ALIGNMENT BUOY MASTER PLAN.

SECTION 10

INTEGRATED LOGISTIC SUPPORT PLAN

A. TEST AND EVALUATION

Logistic support involves Fleet Services and engineering support. NAVSHIPS 1622 will request, through the proper channels, the required Fleet Services. Engineering support will be provided by the Project Office/Division for the system under test. Each test plan will specify the logistic support requirements.

B. MEASUREMENTS

The logistic support plan is contained in the FORACS/ SACS/ ALIGNMENT BUOY Project Master Plan.

SECTION 11

PERSONNEL AND TRAINING

A. PERSONNEL

1. Management Office: At present, the Program Manager's Office is staffed as follows:

a. One GS-14 Section Head with four units, one of which is the System Calibration Unit.

b. One GS-13 Unit Head whose responsibility is Sonar System Calibration and Alignment Evaluation including the FORACS/SACS/ALIGNMENT BUOY Program.

The success of this program depends entirely on sufficient application of qualified technical personnel at the management level. In order to achieve a viable Fleet-wide Sonar System Calibration and Alignment Program, personnel should be increased from one to three by the addition of two GS-12 billets. One of these GS-12 billets would provide project engineering for the facilities effort. The second billet would provide project engineering for operations including test and evaluation. These billets would free the present GS-13 for the program management and liaison responsibilities presently included in that Position Description.

2. Test and Evaluation: The Applied Physics Laboratory, University of Washington (APL/UW) will provide

the scientific effort for this portion of the program. The personnel requirements are outlined below:

		FY 67	FY 68	FY 69
a.	Test and Evaluation Teams			
	1. Scientific	4	4	7
	2. Field Engineering*	6*	6*	6*
b.	Analysts	1	2	2
c.	Planning and Evaluation		3	3

*Field Engineering personnel are presently under contract to the program providing system grooming, etc. This group provided the test team for D/S 395.

3. Facilities Development: Personnel requirements are included in the FORACS/SACS/ALIGNMENT BUOY Project Master Plan. Personnel from that program may participate in the Sonar System Calibration and Alignment Evaluation program in order to best achieve objectives.

B. TRAINING.

The only training involved will be that required by new techniques and systems as they are introduced from the development effort.

is used. These billets would free the present GS-13 for the program management and liaison responsibilities presently included in that Position Description.

2. Alternate Management: In the event that a transfer of FORACS and SACS is not made to NAVELEX or NEL, the minimum management effort that can ensure success if the required program will increase to five billets with a structure similar to that proposed for transfer to NAVELEX or NEL. In addition, some twenty-five field billets must be established at a laboratory. This group would have to be placed under strong scientific management in order to provide the required support.

3. Test and Evaluation: The Applied Physics Laboratory, University of Washington (APL/UW) will provide the scientific effort for this portion of the program. The personnel requirements are outlined below:

		FY 67	FY 68	FY 69
a.	Test and Evaluation Teams			
	1. Scientific	4	4	7
	2. Field Engineering*	6*	6*	6*
b.	Analysts	1	2	2
c.	Planning and Evaluation		3	3

*Field Engineering personnel are presently under contract to the program providing system grooming, etc. This group provided the test team for D/S 395.

SECTION 12

FINANCIAL PLAN

A. TEST AND EVALUATION

Present funding level is $400,000. An increase is required beginning in FY 69 in order to provide the man years of effort required for the estimated one system per six-month period.

FINANCIAL SUMMARY

ITEM	FY67	FY68	FY69	FY70	FY71	FY72	TOTAL
Test & Eval.	400	400	600	600	600	600	3600

Funds are RDT& EN Sonar Fleet Support in $000

SECTION 13

SYSTEM EFFECTIVENESS PLAN

(Not Applicable)

SECTION 14

PROGRESS REPORTS

(Not Applicable)